leptomeningeal contrast enhancement on magnetic resonance imaging (10). Also, B. mandrillaris meningoencephalitis imaging findings are often nonspecific, including cerebral edema, hydrocephalus, multiple space-occupying and ring-enhancing lesions, leptomeningeal enhancement, or formation of mycotic aneurysms (2). Furthermore, amebic trophozoites are seldom detected in CSF by microscopy (2,3). Consequently, B. mandrillaris meningoencephalitis could be underdiagnosed, especially where this infection has no or only sporadic reports.

B. mandrillaris should be considered in refractory or unexplained cases of meningoencephalitis, even outside the Americas and in immunocompetent patients. Detecting *B. mandrillaris* by PCR in CSF seems most likely to enable early diagnosis and timely treatment. However, appropriate therapy is not well defined; success has been sparsely reported with the simultaneous use of azoles, flucytosine, pentamidine, sulfazidine, macrolide antimicrobial drugs, phenothiazines, and miltefosine (2,7,10).

References

- Visvesvara GS, Martinez AJ, Schuster FL, Leitch GJ, Wallace SV, Sawyer TK, et al. Leptomyxid ameba, a new agent of amebic meningoencephalitis in humans and animals. J Clin Microbiol. 1990;28:2750–6.
- Diaz JH. The public health threat from *Balamuthia mandrillaris* in the southern United States. J La State Med Soc. 2011;163:197–204.
- Jayasekera S, Sissons J, Tucker J, Rogers C, Nolder D, Warhurst D, et al. Post-mortem culture of *Balamuthia mandrillaris* from the brain and cerebrospinal fluid of a case of granulomatous amoebic meningoencephalitis, using human brain microvascular

- endothelial cells. J Med Microbiol. 2004;53:1007–12. http://dx.doi.org/10.1099/jmm.0.45721-0
- Kodet R, Nohynkova E, Tichy M, Soukup J, Visvesvara GS. Amebic encephalitis caused by *Balamuthia mandrillaris* in a Czech child: description of the first case from Europe. Pathol Res Pract. 1998;194:423–9. http://dx.doi.org/10.1016/ S0344-0338(98)80033-2
- Tavares M, Correia da Costa JM, Carpenter SS, Santos LA, Afonso C, Aguiar A, et al. Diagnosis of first case of *Balamuthia* amoebic encephalitis in Portugal by immunofluorescence and PCR. J Clin Microbiol. 2006;44:2660–3. http://dx.doi.org/10.1128/ JCM.00479-06
- White JM, Barker RD, Salisbury JR, Fife AJ, Lucas SB, Warhurst DC, et al. Granulomatous amoebic encephalitis. Lancet. 2004;364:220. http://dx.doi.org/10.1016/S0140-6736(04)16640-3
- Matin A, Siddiqui R, Jayasekera S, Khan NA. Increasing importance of *Balamuthia mandrillaris*. Clin Microbiol Rev. 2008;21:435–48. http://dx.doi.org/10.1128/CMR.00056-07
- Qvarnstrom Y, Visvesvara GS, Sriram R, da Silva AJ. Multiplex realtime PCR assay for simultaneous detection of *Acanthamoeba* spp., *Balamuthia mandrillaris*, and *Naegleria fowleri*. J Clin Microbiol. 2006;44:3589–95. http://dx.doi.org/10.1128/JCM.00875-06
- Kiderlen AF, Radam E, Lewin A. Detection of *Balamuthia man-drillaris* DNA by real-time PCR targeting the RNase P gene. BMC Microbiol. 2008;8:210. http://dx.doi.org/10.1186/1471-2180-8-210
- Visvesvara GS, Moura H, Schuster FL. Pathogenic and opportunistic free-living amoebae: *Acanthamoeba* spp., *Balamuthia mandrillaris*, *Naegleria fowleri*, and *Sappinia diploidea*. FEMS Immunol Med Microbiol. 2007;50:1–26. http://dx.doi.org/10.1111/ j.1574-695X.2007.00232.x

Address for correspondence: Jaap J. van Hellemond, Medical Microbiology and Infectious Diseases, Erasmus Medical Centre and Harbour Hospital, PO Box 2040, NL-3000 CA Rotterdam, the Netherlands; email: j.vanhellemond@erasmusmc.nl

<u>etymologia</u>

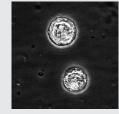
Balamuthia mandrillaris [bal"ə-moo'the-ə man"dril-a'ris]

A free-living ameba naturally found in the environment, *Balamuthia mandrillaris* can cause a serious infection of the brain, other organs (skin, liver, kidneys), and rarely, spinal cord. Originally isolated from the brain of a mandrill that died of meningoencephalitis at the San Diego Zoo, *Balamuthia mandrillaris* is named for the late professor

Sources

- Centers for Disease Control and Prevention. Balamuthia mandrillaris—granulomatous amebic encephalitis (GAE) [cited 2015 Feb 10]. http://www.cdc.gov/parasites/balamuthia/
- Centers for Disease Control and Prevention. Balamuthia mandrillaris transmitted through organ transplantation —Mississippi, 2009. MMWR Morb Mortal Wkly Rep. 2010;59:1165–70.

William Balamuth of the University of California at Berkeley, for his contributions to the study of amebae. More recently, *B. mandrillaris* has been shown to be transmissible through organ transplantation.



- Schuster FL. In memoriam: William Balamuth (1914–1981). J Protozool. 1982;29:1–2. http://dx.doi. org/10.1111/j.1550-7408.1982.tb02872.x
- Visvesvara GS, Schuster FL, Martinez AJ. *Balamuthia mandrillaris*, n. g., n. sp., agent of amebic meningoencephalitis in humans and other animals.
 J Eukaryot Microbiol. 1993;40:504–14. http://dx.doi.org/10.1111/j.1550-7408.1993.tb04943.x

Address for correspondence: Ronnie Henry, Centers for Disease Control and Prevention, 1600 Clifton Rd NE, Mailstop E03, Atlanta, GA 30329-4027, USA; email: boq3@cdc.gov

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